PATENT SPECIFICATION

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Complete Specification Accepted : April 12, 1935.

COMPLETE SPECIFICATION

Improvements in or relating to Radio Beacons

We, TELEFUNKEN GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE M.B.H., a company organised under the laws of Germany, of 12/13 Hallesches Ufer, Berlin, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to radio beacons.

In order that the invention may be the better understood, a known form of radio beacon will first be described with reference to the accompanying figures 1 to 5.

In figure 1, A is a vertical dipole which is coupled to a transmitter S either directly or as shown through a feeder E. A dipole, arranged as so far described, would, of course, as is known, produce an approximately circular horizontal radiation diagram. Parallel to the dipole A is mounted a second wire R which will act, if it be of suitable length and be suitably positioned, as a radiation coupled reflector so that the combination A R will produce a more or less cardioid horizontal radiation diagram as shown in the accompanying figure 2, in which φ is the angle between the vector f (whose length is proportional to the radiation in the direction of its length) and the prolongation of a line joining R to A. As is clearly shown in figure 2, the length of f is a maximum in the direction R A and a minimum in the direction A R. A known form of radio beacon includes an arrangement as shown in figure 2, but having also a second reflector R', preferably exactly like the reflector R, located (as viewed from A) in a different direction from R, e.g. (as shown in the accompanying figure 3) on the side of A opposite from R. With an arrangement as shown in figure 3, if the reflectors are alternately put out of action, the left hand (broken line) and right hand (full line) cardioid radiation curves shown in the accompanying figure 3 will be produced in alternation, and if different distinguishing signals are transmitted when R and R' are respectively in use (e.g. if the transmitter be differently modulated or differently keyed, say, by signals such as the Morse letters A and N), the direction of the intersecting line B' A B becomes available as a guiding line for assisting navigation, for it is only when in this line that a receiver will receive both signals at equal strength.

It is known that the alternate putting into and out of operation of the reflectors R R' may be effected by switching in and switching out conductive portions of the reflector wires, for obviously in the arrangement shown in figure 1, the reflection effect of R will be destroyed if the reflector be open-circuited in the middle. A known arrangement of radio beacon utilising this expedient is shown in the accompanying figure 4, where the switches S and S' alternately "open" the reflectors R and R' and thereby so de-tune them that they become practically of zero effect in alternation.

A practical difficulty with the arrangement as illustrated in figure 4 is that the switches S and S', which are of course constituted in practice by relays, must almost always be arranged at a considerable height above ground at which they are fairly difficult of access, and this disadvantage has been overcome by a known arrangement operating on a principle similar to that illustrated in the accompanying figure 5, wherein the reflectors R and R' are left "open" at O and O' and the ends of the openings are connected by feeders E and E', to points S S' where they are arranged to be short-circuited in alternation by the switch arms (not shown) of relays whose windings are illustrated in the usual conventional manner, the positions of the points S S' on the feeders corresponding to current anti-nodes. Thus, if the dipoles R R' have current anti-nodes at the places O O' the points S S' will be (electrically and taken along E E') at a distance which is an integral multiple of a half wave length away from the points O O' respectively. When the points S or S' are short-circuited, the reflector R or R' is practically effectively a continuous conductor if ordinary precautions are taken to keep the losses on the feeder E or E' small.

The arrangement shown in figure 5 forms no part of the present invention which has for its main object to provide

[*Price* 1/-]

Price 4s (4)

a simplification of the kind of antenna arrangement typified by figure 5 and wherein only two aerials or groups of aerials are employed in place of three.

According to the present invention a radio beacon arrangement of the kind wherein two intersecting radiations each characterised by a different signal (e.g. keyed in alternation with complementary signals) are produced alternately so as to define a plane wherein a predetermined distinguishing joint signal effect is obtainable, is characterised in that the antenna system for producing said radiations is constituted by a single pair of aerials or groups of aerials each of which is connected through a feeder to a remote point where it is associated with keying means adapted to control said aerials or groups of aerials so that they each function alternately as a radiator and reflector respectively.

Referring again to figure 5, it will be seen that since the reflector can be tuned to produce the reflection effect by means of the feeder associated therewith, the reflector wire and associated feeder arrangement can be made the same as the aerial and its associated feeded arrangement, and both aerial and reflector feeders EA and ER (see the accompanying figure 6) may be as shown in the said figure 6 exactly alike as far as their ends away from the aerial or reflector, as the case may be, the only difference being that the one feeder is coupled, for example at M to the transmitter while the other feeder leads to the tuning device K. A switch or commutator device T (e.g. relay operated) then serves to provide the necessary keying action for obtaining reversal of radiation as required for giving the characteristic equi-signal zone, the device T interchanging the connections of the feeders EA and ER with M and K. The full lines indicate the connections for one position of the device T and the dotted lines the other.

A still further improvement which may be provided in accordance with this invention enables any desired ratio to be obtained between aerial current (JA) and reflector current (JR) and any desired phase relationship to be obtained between aerial and reflector. For example, with the usual known arrangements it is not possible to make JA = JR, and at the same time to make the phase relationship 90° (as is desirable for only in this case does the maximum field strength in one direction correspond with zero field strength in the other direction—an obviously desirable result making for good "beacon" effect). Incidentally, it is often desirable to be able definitely to adjust the apparatus to other desired ratios of current and phase.

This object is achieved by coupling the reflector wire also to the transmitter in a predetermined definite manner, for example, as shown in the accompanying figure 7. In this figure the aerial A1 and reflector A2 are both energised and with their associated feeders E1 and E2 respectively, are exactly alike and in the circuits of both feeders are arrangements, known per se, and indicated at J1 and J2 and P1 and P2 respectively, for enabling adjustment of current and phase respectively. For "keying" i.e. for reversing the polarity of the radiation diagrams, a device T corresponding to that of figure 6 is provided as shown.

The sharpness or distinctness of the radio beacon effect depends on the slope of the field strength curves at their point of intersection, and in general it is desirable to make this slope as steep as possible. Clearly a dipole aerial and a corresponding reflector dipole will only give more or less cardioid or kidney-shaped curves and correspondingly moderately steep slopes at the points of intersection of the field strength curves. The object of a further feature of the invention is to provide arrangements giving more steeply sloping field strength curves and thereby enabling the production of narrower, sharper equi-signal "guiding" zones.

This object is achieved by a modification of the arrangement illustrated in Figure 7, use being made of a system wherein similar feeders and similar aerials which are themselves directional have their connections interchanged for the purpose of keying to reverse the polarity of the radiation diagram and produce the equi-signal zone.

Referring to the accompanying figure 8, A1 denotes a directional aerial so positioned as to have a radiation diagram D1, and A2 a second similar directional aerial so positioned as to have a radiation diagram D2. The aerial A1 is fed by the feeder E1, the aerial A2 by the feeder E2, and the feeders E1 and E2 lead through a keying device T, arranged as described in connection with figures 6 and 7, to reverse the connections, and thence through amplitude and phase regulation apparatus at J1, J2, P1, P2 to a high frequency transmitter S. If both aerials A1, A2 are exactly similar and each consists for example, of four dipoles fed in the same phase, and the two aerials A1, A2 are so positioned that the angle between the maximum radiation directions of diagrams D1, D2 is a suitable amount, radiation curves having very

steep slopes (as indicated) at the points of intersection may be obtained and thus a very sharp radio beacon effect obtained in the direction A B.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A radio beacon arrangement of the kind wherein two intersecting radiations each characterised by a different signal (e.g. keyed in alternation with complementary signals) are produced alternately so as to define a plane wherein a predetermined distinguishing joint signal effect is obtainable, characterised in that the antenna system for producing said radiations is constituted by a single pair of aerials or groups of aerials each of which is connected through a feeder to a remote point where it is associated with keying means adapted to control said aerials or groups of aerials so that they each function alternately as a radiator and reflector respectively.

2. A radio beacon arrangement as claimed in claim 1 and wherein the antenna system is constituted by a single pair of dipole aerials.

3. An arrangement as claimed in claim 1 or 2 and in which the aerial or aerials which is or are at any instant serving as a reflector is or are tuned to function as a radiation coupled reflector.

4. An arrangement as claimed in claim 1 or 2 and in which the aerial or aerials which is or are at any instant serving as a reflector is or are energised in the required phase relationship from the transmitter.

5. A modification of the arrangement claimed in claim 1 and wherein the intersecting radiations are each produced by a separate directional aerial system each of which is connected through a feeder to a remote point where it is associated with keying means adapted to connect said aerial systems alternately to the transmitter.

6. An arrangement as claimed in claim 5 and in which the directional aerial systems are each constituted by a plurality of co-phasally energised dipoles.

7. Radio beacon arrangements in accordance with any of the preceding claims substantially as herein described and illustrated in figures 6, 7 and 8 of the accompanying drawings.

Dated this 20th day of September, 1934

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London, W.C.2.

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Fig. 1.

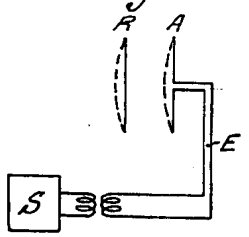


Fig. 2.

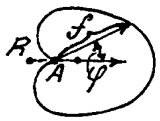


Fig. 3.

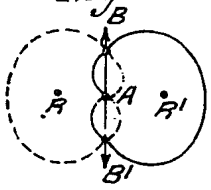


Fig. 4.

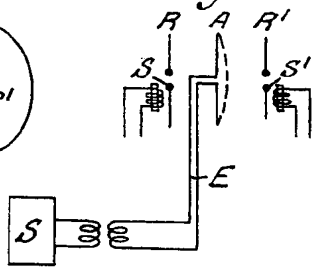


Fig. 5.

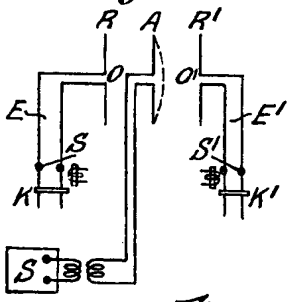


Fig. 6.

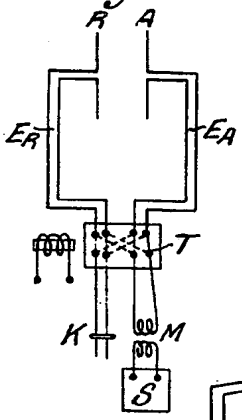


Fig. 7.

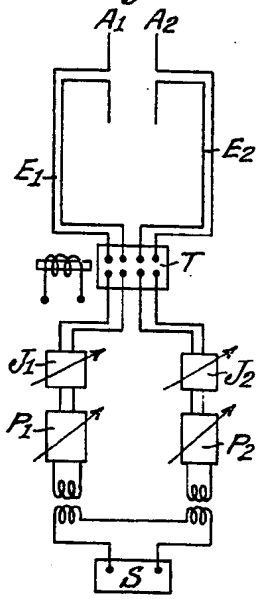
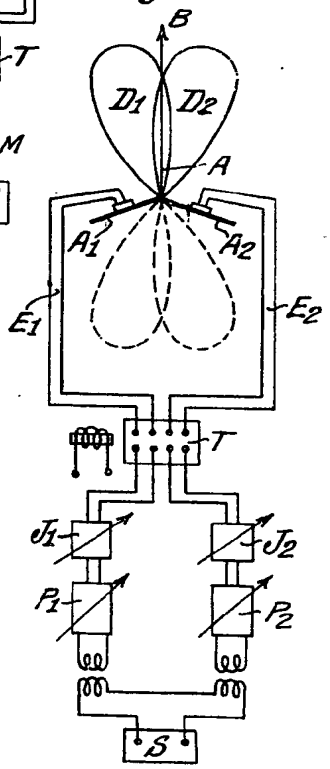


Fig. 8.



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